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ORIGINAL RESEARCH

A rapid post-disaster surveillance model enabling outbreak detection and healthcare response following earthquakes on Kefalonia island, Greece, February–May 2014

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ABSTRACT

Introduction: In early 2014, earthquakes struck the island of Kefalonia in Greece, causing damage to facilities and houses. An onsite investigation concluded that existing surveillance systems might not have been able to identify events of public health interest.
Methods: A syndrome surveillance system was implemented and an additional system was designed for strengthening surveillance at the most affected area, Paliki. The first system was a daily reporting system of three clinical syndromes (fever, respiratory, gastrointestinal) including seven healthcare services of the island. The second system involved the local mayors in reporting any

unusual health event in the villages of their jurisdiction. The two systems were in force from 7 February to 31 May 2014. This article describes the implementation of the two systems, presents their results, evaluates their performance and present the lessons learned from this experience.

Results: The evaluation of the systems showed they performed well and fulfilled their objectives. One gastroenteritis outbreak was identified, enabling the timely implementation of control measures.

Conclusions: Strengthening surveillance not only assured the timely identification of possible events of public health interest but also reassured the authorities and the population of the absence of a major event.

Key words: disease outbreak, earthquake, Greece, Kefalonia, natural disaster, public health surveillance, syndrome surveillance.

Introduction

On 26 January and 3 February 2014, two earthquakes of magnitude 6.1 struck Kefalonia island (35 801 permanent residents[1]) in western Greece. The epicenter, Paliki, is located 9 km from the capital, at the western peninsula of Kefalonia, with a population of 6500 residents. There was severe damage at one of the two local hospitals, the health care center, approximately 1500 houses of Paliki and the water supply system[2,3]. Displaced residents were offered shelter at two cruise ships that arrived at the island on 28 January and 8 February 2014 and stayed for 22 and 44 days, respectively.

On 3 February, the Hellenic Centre for Disease Control and Prevention (HCDCP) was informed through the media[4,5] about the occurrence of gastroenteritis on one of the ships. An onsite investigation concluded this was a false alarm; however, it also revealed that existing surveillance systems might not have been able to identify similar events in a timely manner. As a result, the implementation of a syndrome surveillance system (SSS) was decided. It was also noted that the population living in Paliki area had a limited access to local healthcare services due to the damaged road network and thus an additional system was designed for strengthening surveillance at this area.

This article aims to describe the implementation of the two systems, present their results, evaluate their performance and present the lessons learned from this experience.

Methods

Systems

Syndrome surveillance system: The objective of the SSS was to detect in a timely manner clusters or outbreaks requiring immediate action and to provide reliable epidemiological information to the municipality of Kefalonia and the local public health authorities. The authors identified seven healthcare services to use as reporting sites (the two public hospitals, the local healthcare center, the two community centers and the medical centers of the two cruise ships). Reporting was case-based and a single-page form was created including demographic and symptoms data. A separate form was used for zero reporting. Notifications were sent daily by midday (including weekends) via fax or email directly to HCDCP. HCDCP personnel actively sought reports not received on time by calling the assigned contact points. The population under surveillance was all residents and visitors on the island from 7 February to 31 May 2014.

Based on the literature on communicable diseases that have been associated with similar natural disasters[6], and taking into account the pre-earthquake health status of the population, vaccination coverage, the relatively good living conditions and the capacity of the local laboratories to perform routine testing, the authors decided to include fever, respiratory and gastrointestinal syndromes in the SSS. The definitions were based on the US Centers for Disease Control and Prevention syndrome definitions[7] (Table 1). Also, data providers were asked to report any unusual health event/condition.

The authors provided one-day training to the identified contact points of the medical services on case definitions, filling in the forms etc. and all the material was uploaded at the web page of the local medical association. The contact points were informed that this was a local, provisional and time-limited system that did not replace the existing reporting systems.

A database was created with the use of EpiData and data analysis was performed with Stata v12 (StataCorp; http://www.stata.com).

The number of reports per day, by syndrome, reporting site, place (nine municipalities) and type of residence (household or shelter) were recorded, as well as the response rate (number of passively collected reports per reporting day) for each reporting site.

An alarm was defined as an increase in the observed number of syndrome reports in the same municipality exceeding the mean number of reports for the three previous days plus two standard deviations. Alarms due to single cases were excluded. Each alarm was investigated by epidemiologists of HCDCP in cooperation with the local public health directorate (PHD).

Paliki enhanced surveillance system: The objective of the Paliki enhanced surveillance system (PSS) was to obtain health information from local authorities in order to detect unmet healthcare needs, including outbreaks and unusual events, which could then be addressed by directing healthcare resources to this remote area. The system was based on the network of mayors of the municipal authorities. Residents were asked to report any illness to mayors and contacted mayors daily (at 10.00 am) by phone, asking if there was any unusual health event in the villages of their jurisdiction. Each report was followed up. This system was in force until 31 May 2014.

Evaluation of the systems

In order to evaluate the SSS, timeliness (time interval between examination and reporting), sensitivity and completeness (percentage of passively collected reports by reporting site and percentage of missing information by field) were addressed. For the evaluation of the PSS, acceptability (proportion of the local authorities that agreed to participate in the system) and sensitivity (comparing the number of outbreaks reported to the system with reports from other sources such as other surveillance systems, PHD and media) were addressed.

Ethics approval

Personal data were protected according to Greek law (2472/1997). HCDCP personnel are legally authorised to use personal data for surveillance purposes (3204/23-12-2003). All the data were kept using personal information protection policy in compliance with the Helsinki Declaration and were used only for surveillance purposes.

Results

Syndrome surveillance system

From the 1423 notifications of the SSS, 54% were zero reports, of which the vast majority (88%) were actively collected by HCDCP personnel. The response rate varied among the reporting sites (4–95%).

Overall, 646 syndromes were recorded: 397 (61%) fever, 158 (25%) respiratory and 90 (14%) gastrointestinal cases. Most of the cases were residents living in their own houses (96%) and only 4% of the cases were residents staying on a cruise ship.

From the evaluation of the 61 alarms (7 gastrointestinal, 27 respiratory and 27 fever), only one alarm of gastrointestinal syndrome was verified as an outbreak. The true alarm was a cluster of 22 gastroenteritis cases among soldiers that had consumed a meal prepared by the same catering company. Soldiers developed diarrhea and abdominal pain 6–7 hours after consuming a meal on 14 February. The company had prepared 400 portions that day, which had been distributed throughout the island. The type of symptoms, the onset and duration (less than 24 hours) and the lack of secondary cases indicated this was probably a food poisoning caused by a toxin. No clinical sample

was collected for laboratory testing. An inspection took place at the premises of the company and several hygiene failures were identified. The PHD closed down the catering company for 10 days so that the appropriate measures could be taken. Recommendations to all possible consumers to dispose of any lunch boxes prepared that day by the company led to the disposal of 250 lunch boxes, possibly preventing the occurrence of more cases. No further cases were reported.

Paliki enhanced surveillance system

The PSS system had 20 reports (fever cases and influenza-like cases). No outbreak was identified after investigation and no public health action was required.

Evaluation of the systems

For SSS, the time interval from examination to reporting was 1 day (range 0–4 days). The percentage of the reports through SSS received either passively or actively from the reporting sites was 100%. The proportion of passively received reports varied between different reporting sites. Completeness was above 90% for all variables. The authors were not informed by other sources for any other outbreak during this period, so the only known outbreak was identified by the SSS; however 60 out of the 61 alarms were proved to be false.

The PSS acceptability was very high – all mayors agreed to participate. According to the data available, no outbreak was identified in this area at the same period.

Discussion

Several different approaches have been used for post-disaster surveillance based on the baseline surveillance systems, the surveillance needs, the population characteristics, and the geographical and political settings[8-17] . As with other similar systems used elsewhere, the SSS performed well and fulfilled its objectives[8,10-12,14] , and no unexpected or uncommon disease was reported apart from one gastroenteritis outbreak, verifying that the risk for infectious diseases after natural disasters is low[11,13,17].

The main limitations of the present system were the absence of comparable historical data, and the low specificity of the system. Setting up a time-series-based alarm proved helpful. Keeping the balance between sensitivity and specificity is always an issue when implementing an SSS given the amount of effort required for investigating false alarms[18-23] . Based on the results, setting the alarm threshold from two cases to three or more would have probably been a more efficient choice.

As the proportion of active–passive reports showed, telephone reports may have been a more suitable choice than fax or email reporting due to lack of means at reporting sites. The majority of zero reports were obtained actively, suggesting that reporters prioritise case reports over zero reporting, a finding consistent with similar systems implemented elsewhere[10,11,16] .

Finally, reporting by non-medical local municipality authorities can be considered for meeting the purposes of surveillance in remote areas.

Overall, the authors conclude that even though the risk of major events after a natural disaster in a developed country is low, strengthening surveillance is needed not only for assuring the timely identification of events of public health interest but also for reassuring the authorities and the population of the absence of a major event[11,12,24] .

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Table 1: Syndrome definitions, Kefalonia syndrome surveillance system, Kefalonia island, Greece, February – May 2014

Syndrome	Description
Respiratory	Fever ≥38°C AND at least one of rhinitis, cough, redness or soreness of throat, fast breath AND at least one of cough, difficulty breathing. Respiratory distress in children aged <5 years: breathing ≥50 times per minute for infants aged 2 months – 1 year; breathing ≥40 times per minute for children aged 1–5 years; or severe respiratory distress in a child might be signalled by an inability to drink or breastfeed, persistent vomiting, convulsions, lethargy, or chest indrawing or stridor in a calm child.
Gastrointestinal	Three or more abnormally loose or fluid stools (with or without blood) in the past 24 hours OR at least two vomits OR two fluid stools (with or without blood) and one vomit, with or without dehydration, with or without known etiology.
Fever	Body temperature >38.5°C for >48 hours with or without known etiology.

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